

5th Annual LLNL Deterrence Workshop Multi-Domain Strategic Competition: Rewards and Risks

Annotated Bibliography

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5th Annual LLNL Deterrence Workshop
Multi-Domain Strategic Competition: Rewards and Risks

Center for Global Security Research, Lawrence Livermore National Laboratory
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Key Questions:

1. How do the United States, Russia, and China approach strategic competition in their defense strategies?
2. How should the United States and its allies integrate efforts to improve strategic competitiveness with efforts to strengthen deterrence?
3. What impact might new forms of strategic competition have on strategic stability?
4. How can the United States and its allies reap the disruptive and deterrence benefits of new technologies while avoiding the unintended consequences?

Panel Topics:

1. Strategic Competition and US Strategy
2. Strategic Competition as Practiced by Russia and China
3. Competing for Long-Term Advantage in the New Domains
4. Competition and Deterrence: Complementary or Contradictory?
5. Competing for Escalation Dominance in a Contested Multi-Domain Environment
6. The Future of Crisis Stability: Catastrophic Decay or Piecemeal Reinforcement?
7. The Competitive Future: Unbridled or Managed Competition?
8. Out-Thinking our Adversaries

Panel 1: Strategic Competition and US Strategy

- What key ideas have been set out?
- What are we competing for, precisely?
- Is there a theory of victory or success?

Marshall, Andy W. *Long-Term Competition with the Soviets: A Framework for Strategic Analysis*. Santa Monica, CA: RAND Corporation, 1972. <https://www.rand.org/pubs/reports/R862.html>.

In this pioneering 1972 report, Marshall develops a framework for analysis of the long-term strategic arms competition between the United States and the Soviet Union. He concludes that it is insufficient and likely self-defeating to try to outspend the Soviets in the endless military-economic-political competition. Instead, he proposes to “steer the competition in ways that reduce the efficiency with which Soviet resources are used, or to steer the competition into areas of U.S. comparative advantage.”

Mahnken, Thomas G., ed. *Competitive Strategies for the 21st Century: Theory, History, and Practice*. Stanford, CA: Stanford University Press, 2012. <http://www.sup.org/books/title/?id=22068>.

In a book published in 2012, Mahnken et al. explore how theories developed in the Cold War to prevail in long-term competition with the Soviet Union can be adapted to meet the 21st century challenges of long-term competition with China. See especially chapter 2 by Stephen Rosen, which examines the theoretical foundations and practical limits of such competitive strategies.

Mahnken, Thomas G. *Cost-Imposing Strategies: A Brief Primer*. Washington DC: Center for a New American Security, November 2014. <https://www.cnas.org/publications/reports/cost-imposing-strategies-a-brief-primer>.

In a 2014 primer on competitive strategies, Mahnken identifies the potential roles of cost-imposing strategies in dealing with long-term challenges in the Asia-Pacific. Mahnken argues that such cost-imposing strategies are in fact one version of a broader set of competitive strategies that can be tailored for different purposes.

Relevant Documents of the Trump Administration:

- White House. *National Security Strategy of the United States of America*. Washington DC, 2017, pp. 25-35 (great power competition). <https://www.whitehouse.gov/wp-content/uploads/2017/12/NSS-Final-12-18-2017-0905.pdf>.
- United States Department of Defense. *Summary of the National Defense Strategy*. Washington DC, 2018. <https://www.defense.gov/Portals/1/Documents/pubs/2018-National-Defense-Strategy-Summary.pdf>.

- United States Department of Defense. *Nuclear Posture Review*. Washington DC, 2018, pp. 5-11 (great power competition), pp. 30-32 (tailored strategies), pp. 51-55 (supplemental nuclear capabilities), pp. 72-74 (role of arms control).
<https://dod.defense.gov/News/SpecialReports/2018NuclearPostureReview.aspx>.
- White House. "President Donald J. Trump is Unveiling an America First National Space Strategy." Washington DC, 2018. <https://www.whitehouse.gov/briefings-statements/president-donald-j-trump-unveiling-america-first-national-space-strategy/>.
- White House. *National Cyber Strategy of the United States*. Washington DC, 2018, pp. 20-21 (persistent engagement). <https://www.whitehouse.gov/wp-content/uploads/2018/09/National-Cyber-Strategy.pdf>.
- White House. *National Strategic Overview for Quantum Information Science*. Washington DC, 2018. <https://www.whitehouse.gov/wp-content/uploads/2018/09/National-Strategic-Overview-for-Quantum-Information-Science.pdf>.

Trump Administration Statements on strategies toward China and Russia:

- Pence, Mike. "Remarks by Vice President Pence on the Administration's Policy Toward China." Hudson Institute, Washington DC, 4 October 2018.
<https://www.whitehouse.gov/briefings-statements/remarks-vice-president-pence-administrations-policy-toward-china/>.
- Mitchell, A. Wess. "U.S. Strategy Toward the Russian Federation." Remarks at Senate Foreign Relations Committee, Washington DC, 21 August 2018.
<https://www.state.gov/p/eur/rls/rm/2018/285247.htm>.

Panel 2: Strategic Competition as Practiced by Russia and China

- How do they compete with the United States?
- Toward what ends?
- How have they organized for success?

Deni, John, ed. *Current Russia Military Affairs: Assessing and Countering Russian Strategy, Operational Planning, and Modernization*. Strategic Studies Institute, U.S. Army War College, July 2018. <https://ssi.armywarcollege.edu/pubs/display.cfm?pubID=1385>.

This compendium of essays informs the discussion about Russian competition with the United States through analysis of Russian strategy, planning, and force modernization. The essay by Kristin Ven Bruusgaard addresses question one by outlining the contours of Russian strategic and asymmetric competition with the United States. She argues that Russian strategic competition focuses on maintaining a secure and effective second strike and ensuring both nuclear and conventional options for responding to conventional aggression, while Russian asymmetric competition aims at developing non-traditional capabilities which undermine an adversary's will to begin or sustain conflict operations. Eugene Rumer and Angela Stent suggest an answer to question two of this panel, arguing that Russian strategy aims at maintaining regime stability at home while renegotiating the post-Cold War world order. With respect to question three, Andrew

Monaghan explores structural, organizational, and political challenges Russia faces in planning and implementing its strategy, including: uncertainty in forecasting, competing bureaucratic interests, a limited bureaucratic capacity, the Soviet economic legacy, and a dysfunctional chain of command.

Barrass, Gordon, and Nigel Inkster. "Xi Jinping: The Strategist Behind the Dream." *Survival* 60, no. 1 (2018): 41-68. <https://www.tandfonline.com/doi/full/10.1080/00396338.2018.1427363>.

The authors argue that Chinese strategic thinking is heavily influenced by both Sun Tzu and Andy Marshall, particularly their ideas about non-military means of conflict resolution and long-term competition. Together with the Chinese conception of sovereignty, which emphasizes dominance rather than non-interference, these ideas guide contemporary Chinese strategic competition with the United States.

Cheung, Tai Ming, Thomas G. Mahnken, eds. *The Gathering Pacific Storm: Emerging U.S.-China Strategic Competition in Defense Technological and Industrial Development*. Amherst, NY: Cambria University Press, 2018.

This book explores the science and technology dimension of Chinese strategic competition with the United States, focusing in part on China's use of industrial policy to gain a dominant position in multiple technology sectors.

Bendett, Samuel, and Elsa B. Kania. "Chinese and Russian Defense Innovation, with American Characteristics? Military Innovation, Commercial Technologies, and Great Power Competition." *The Strategy Bridge* (2018). <https://thestrategybridge.org/the-bridge/2018/8/2/chinese-and-russian-defense-innovation-with-american-characteristics-military-innovation-commercial-technologies-and-great-power-competition>.

Bendett and Kania observe that China and Russia are incorporating aspects of the U.S. approach to technological innovation for military modernization. Like the U.S., both countries have launched their own versions of DARPA and DIUx, embrace competitions and challenges in technological innovation, and are leveraging public-private platforms and partnerships. The authors caution that these efforts could challenge U.S. primacy in technological innovation in the future.

Panel 3: Competing for Long-Term Advantage in the New Domains

- What goals guide the competition in cyber space, outer space, AI, and other new technologies?
- What results can we expect from a competition for dominance?
- What rewards and risks can be expected?

Fischerkeller, Michael P., and Richard J. Harknett. *Persistent Engagement, Agreed Competition, Cyberspace Interaction Dynamics, and Escalation*. Washington DC: Institute for Defense

Analyses, May 2018.

https://www.ida.org/idamedia/Corporate/Files/Publications/IDA_Documents/ITSD/2018/D-9076.pdf.

Fischerkeller and Harknett posit that the U.S. strategy of persistent engagement in cyberspace can lead to de-escalation and stabilization, arguing that *interaction dynamics* and escalation dynamics can be mitigated in an agreed competition in cyberspace. They maintain that persistent engagement specifically counters the dynamics of widening, compounding, and intensification.

Center for Global Security Research, Lawrence Livermore National Laboratory. *Space in 21st Century Conflict: Calibrating Risks, Tailoring Strategies*. Workshop Summary. Livermore: CGSR, March 2018. https://cgsr.llnl.gov/content/assets/docs/Space_Report_Final_03-012-18.pdf.

The workshop was convened at CGSR in March 2018 to examine the role of space in 21st century conflict. See panel two for a discussion of U.S. efforts to maintain leadership and freedom of action in outer space under the Trump Administration's policy objective of "space preeminence." In order to achieve this objective, the U.S. is increasing its emphasis on defending military and civilian space assets through enhanced space control and resilience and integrating space with other domains, such as cyber, and special operations forces to enhance all-domain deterrence. See panel three for a discussion on Russian and Chinese competitive efforts in space. Russia and China, believing that space is critical to non-contact warfare and information dominance, strive to undermine U.S. space-based assets with strategies that call for counterspace systems with a wide array of capabilities, including cyber and electronic warfare.

Horowitz, Michael C. et al. *Strategic Competition in an Era of Artificial Intelligence*. Washington DC: Center for a New American Security, July 2018. https://s3.amazonaws.com/files.cnas.org/documents/CNAS-Strategic-Competition-in-an-Era-of-AI-July-2018_v2.pdf?mtime=20180716122000.

From a military and economic perspective, is AI a technology that will generate and sustain first mover advantages? From a societal perspective, is AI an enabling or disruptive technology? The authors consider these questions as they attempt to identify elements of the international competition in AI, arguing that competitive states must: 1) harness a large quantity of quality data; 2) develop an adequate training program; 3) allocate resources to generate and sustain the required computing capacity; 4) embrace organizational flexibility and adaptivity; 5) leverage public-private cooperation; and 6) demonstrate political will.

Kania, Elsa B., and John Costello. *Quantum Hegemony? China's Ambitions and the Challenge to U.S. Innovation Leadership*. Washington DC: Center for a New American Security, September 2018. <https://www.cnas.org/publications/reports/quantum-hegemony>.

Kania and Costello caution that China's rapid advancements in quantum science, enabled by virtually unlimited state funding and resources, could alter the strategic balance in the future. For example, advancements in quantum cryptography could undermine U.S. cyber and signals-intelligence capabilities, while progress in quantum radar, imaging, and sensing could undermine traditional U.S. military advantages, for example, in stealth technology. In addition, Chinese advancements in quantum communications could enable underwater communications, thereby challenging U.S. dominance in the undersea domain.

U.S. Army Training and Doctrine Command (TRADOC) G-2. *The Operational Environment and the Changing Character of Future Warfare*, May 2017.

http://arcic.army.mil/App_Documents/The-Operational-Environment-and-the-Changing-Character-of-Future-Warfare.pdf.

The authors argue that the U.S. military finds itself at a historical inflection point. Time-honored successes and the ideas, concepts, doctrine, equipment, training, and personnel that achieved them probably are insufficient to achieve successes in the near-term, and certainly are, if not revised or re-assessed, insufficient in the mid- to long-terms. The authors forecast that, given the transformative impact of technology and the increasing speed of human interaction, the evolution of the future operational environment will be divided into two distinct periods. In the Era of Accelerated Human Progress, 2017-2035, U.S. adversaries will be able to take advantage of new technologies, new doctrine, and revised strategic concepts to effectively challenge U.S. military forces across multiple domains. During the Era of Contested Equality, 2035-2050, no one actor is likely to have any long-term strategic or technological advantage, with aggregate power between the U.S. and its peer and near-peer rivals being equivalent, but not necessarily symmetric.

Panel 4: Competition and Deterrence: Complementary or Contradictory?

- To what extent are they complementary? Contradictory?
- Can US strategy be coherent while supporting both objectives? How?

Friedberg, Aaron L. "Competing with China." *Survival* 60, no. 3 (2018): 7-64.

<https://www.tandfonline.com/doi/full/10.1080/00396338.2018.1470755>.

Friedberg maintains that prevailing policies towards China have failed and that an alternative approach is now urgently required. A new U.S. China strategy should include stepped-up balancing and constrained engagement, each of which comprises two components: diplomacy and military policy, in the first instance, and economic policy and information operations (or political warfare), in the second.

Miller, Jr., James N., and Richard Fontaine. *Navigating Dangerous Pathways: A Pragmatic Approach to U.S.-Russian Relations and Strategic Stability*. Washington DC: Center for a New

American Security, January 2018. <https://www.cnas.org/publications/reports/navigating-dangerous-pathways>.

Miller and Fontaine argue that managing the competition between the U.S. and Russia and protecting U.S. and allied interests requires parallel actions along three pathways: 1) a clear-eyed, deliberate, and strong American approach to U.S.-Russian relations; 2) concrete U.S. steps aimed at reducing the increasing risks of rapid unintended escalation; and 3) unilateral U.S. actions or bilateral agreements with Russia to bolster strategic stability. While steps to bolster deterrence are necessary, they are not sufficient alone.

Panel 5: Competing for Escalation Dominance in a Contested Multi-Domain Environment

- How are cold war models of escalation control helpful and unhelpful?
- Is it possible to orchestrate multi-domain “strikes” to mass effects?
- Are there multi-domain analogues to the competition of risk-taking in the nuclear domain?

Fitzsimmons, Michael. “The False Allure of Escalation Dominance.” *War on the Rocks*, November 16, 2017. <https://warontherocks.com/2017/11/false-allure-escalation-dominance/>.

The core of Fitzsimmons’ argument is that the concept of escalation dominance has always suffered from serious flaws and is particularly poorly suited to the regional deterrence challenges the United States faces in the 21st century. At least five problems are cause for concern: asymmetric stakes, conventional balance, information and decision-making challenges, influence of new technologies, and peacetime provocation.

Morgan, Forrest E. “Dancing with the Bear: Managing Escalation in a Conflict with Russia,” *IFRI Proliferation Papers*, no. 40 (Winter 2012). <https://www.ifri.org/sites/default/files/atoms/files/pp40morgan.pdf>.

Morgan argues that Cold War models of escalation management – Herman Kahn’s escalation dominance, Thomas Schelling’s brinkmanship, and conflict avoidance – are of limited value to the geopolitical environment of the 21st century. Explaining shortcomings of those concepts, Morgan proposes an approach to escalation control based on threshold management and describes how it might be applied to mitigate escalation risks in conflict with Russia.

Army Capabilities Integration Center. *Multi-Domain Battle: Evolution of Combined Arms for the 21st Century, 2025-2040, Version 1.0*, October 2017. http://www.arcic.army.mil/App_Documents/Multi-Domain-Battle-Evolution-of-Combined-Arms.pdf.

This document is a first draft of what may become an U.S. joint operating concept for Multi-Domain Battle. It offers initial ideas about how U.S. ground forces, as part of the Joint Force and with partners, will operate, fight, and campaign successfully across all domains—space, cyberspace, air, land, maritime—against peer adversaries in the 2025-2040 timeframe. Among its components of the solution, the concept highlights that defeating an adversary in contested environment depends on converging capabilities across multiple domains, environments, and functions to create and exploit physical, virtual and cognitive windows of advantage.

Panel 6: The Future of Crisis Stability: Catastrophic Decay or Piecemeal Reinforcement?

- Will future political-military crises be more or less stable than past crises?
- What are the requirements of crisis stability in the new multi-domain context?
- What are the similarities and differences with cold war concepts?

Delpech, Thérèse. "Chapter 4: Lessons from Crises." In *Nuclear Deterrence in the 21st Century: Lessons from the Cold War for a New Era of Strategic Piracy*, 61-92. Santa Monica, CA: RAND Corporation, 2012. <https://www.rand.org/pubs/monographs/MG1103.html>.

The chapter re-examines a range of Cold War crises and the responses and behavior of the participants to draw key lessons for the 21st century security environment.

Gompert, David C., and Phillip C. Saunders. "Sino-American Strategic Restraint in an Age of Vulnerability." *Strategic Forum* (January 2012).
<http://ndupress.ndu.edu/Portals/68/Documents/stratforum/SF-273.pdf>.

Gompert and Saunders note that despite their vast power, the United States and China are becoming increasingly and mutually vulnerable in three key strategic domains – nuclear, space and cyber – and that dim arms control prospects will lead each to develop stronger offensive capabilities to deter the other. The authors suggest mutual restraint, including no first use pledges in the nuclear, antisatellite and cyber spheres.

Miller, Jr., James N., and Richard Fontaine. *A New Era in U.S.-Russian Strategic Stability: How Changing Geopolitics and Emerging Technologies are Reshaping Pathways to Crisis and Conflict*. Washington DC: Center for a New American Security, September 2017.
<https://s3.amazonaws.com/files.cnas.org/documents/CNASReport-ProjectPathways-Finalb.pdf?mtime=20170918101504>.

Miller and Fontaine note that the United States and Russia have re-entered a period of serious tension, exacerbated by such emerging capabilities as long-range precision strike, cyber, space and autonomous systems. They contend that unless measures are taken to cushion the consequences of these trends, escalation may become more dramatic and conflict more probable. Their report highlights the problem and offers a framework for understanding and organizing it.

*For further reading on crisis stability in each of the new domains, see:

- Gartzke, Erik and Jon R. Lindsay, “Thermonuclear Cyberwar.” *Journal of Cybersecurity* 3, no. 1 (2017): 37-48. <https://academic.oup.com/cybersecurity/article-pdf/3/1/37/11155836/tyw017.pdf>.
- Finch, James P. “Bringing Space Crisis Stability Down to Earth.” *JFQ* 76, 1st Quarter (2015). <http://ndupress.ndu.edu/JFQ/Joint-Force-Quarterly-76/Article/577582/bringing-space-crisis-stability-down-to-earth/>.
- Leys, Nathan. “Autonomous Weapon Systems and International Crises.” *Strategic Studies Quarterly* (Spring 2018). https://www.airuniversity.af.mil/Portals/10/SSQ/documents/Volume-12_Issue-1/Leys.pdf?ver=2018-02-14-165959-950.
- Geist, Edward and Andrew J. Lohn. *How Might AI Affect the Risk of Nuclear War?* Santa Monica, CA: RAND Corporation (2018). <https://www.rand.org/pubs/perspectives/PE296.html>.

Panel 7: The Competitive Future: Unbridled or Managed Competition?

- Is reciprocal restraint possible? Among whom?
- Can formal and/or informal arms control measures be used to favorably manage new forms of competition? If so, how?
- Is unilateral restraint sensible? Under what conditions?

Center for Global Security Research, Lawrence Livermore National Laboratory. *U.S.-Russian Nuclear Arms Control: Crisis and Collapse or Crossroads?* Workshop Summary. Livermore: CGSR, July 2018. https://cgsr.llnl.gov/content/assets/docs/RU_US_Arms_control_summary_2018.pdf.

The workshop was convened at CGSR in June 2018 to explore alternative pathways forward for bilateral nuclear arms control. Strategic restraint in the new domains seems unlikely if the arms control framework entirely collapses, but it is also not clear that success in preserving it is a sufficient condition for new forms of restraint in the new domains. Eight panels each addressed different topics from United States and Russian arms control incentives to challenges of European nuclear stability.

Frear, Thomas, Lukasz Kulesa, and Denitsa Raynova. *Russia and NATO: How to overcome deterrence instability?* London, UK: European Leadership Network, April 2018. <https://www.europeanleadershipnetwork.org/report/russia-and-nato-how-to-overcome-deterrence-instability/>.

The report suggests that the prevailing NATO-Russia deterrence relationship is dangerously unstable given the interplay between the two camps’ postures. While Russia’s “integrated strategic deterrence” envisages taking significant preemptive action to dominate early stages of conflict and capitalizes on unpredictability, NATO’s “modern deterrence” remains torn between projecting restraint and deterring Russia. The interplay creates danger of misunderstandings and rapid escalation. The authors argue

that informal measures, such as unilateral re-examination of deterrence postures and mutual creation of space for crisis management diplomacy, can reduce the risks of inadvertent escalation and conflict.

Haas, Ryan. *Principles for Managing U.S.-China Competition*. Washington DC: Brookings Institution, August 2018. <https://www.brookings.edu/research/principles-for-managing-u-s-china-competition/>.

Haas notes that, barring presidential-level intervention, the relationship between the United States and China will continue to deteriorate. He suggests there are ample steps the leaders could take to construct guardrails to keep competition within mutually acceptable bounds, including development of a shared narrative for the relationship, use of summits as action-forcing mechanisms, revival of “no surprises” policy for key actions impacting bilateral relations and delineation of steps for better managing acute irritants, like trade, cyber, Taiwan and North Korea.

Center for Global Security Research, Lawrence Livermore National Laboratory. *Cyberspace, Information Strategy and International Security*. Workshop Summary. Livermore: CGSR, February 2018. https://cgsr.llnl.gov/content/assets/docs/CGSR_Cyber_Workshop_2018_Summary_Report_Final2.pdf.

The workshop was convened at CGSR in February 2018 to focus on cyberspace, information technology and international security. Eight panels discussed different aspects of the evolving cyber strategies of the United States, its allies and adversaries. They grappled with the cyber domain’s complex characteristics, its escalation risks and the ways in which the “dual use” nature of much of the underlying technology of cyberspace connects actions within the domain to broader questions of internet governance and global security.

Chow, Brian G. “Space Arms Control: A Hybrid Approach.” *Strategies Studies Quarterly* (Summer 2018): 107-132. https://www.airuniversity.af.mil/Portals/10/SSQ/documents/Volume-12_Issue-2/Chow.pdf?ver=2018-05-21-172324-077.

Chow argues that existing space arms control proposals – like the Prevention of the Placement of Weapons in Outer Space Treaty – are not feasible in the burgeoning space proximity operations era. Instead, he proposes a hybrid space arms control treaty restricting satellite proximity as opposed to outright bans on classes of satellites.

Panel 8: Out-Thinking our Adversaries

- What kind of thinking needs to be done, specifically?
- By whom? In what kinds of institutions?
- What else needs to be done to accelerate conceptual innovation for this new problem?

“Promoting DoD's Culture of Innovation.” Statement of Dr. Mike Griffin, Under Secretary of Defense for Research and Engineering before the House Armed Services Committee, 17 April 2018. <https://docs.house.gov/meetings/AS/AS00/20180417/108132/HHRG-115-AS00-Wstate-GriffinM-20180417.pdf>.

Griffin observes that the United States military's previously unmatched technological superiority is now being challenged by the advancements of competing powers. He explains that in light of the leveling playing field, speed in developing new technologies and delivering them to warfighters is more critical now than ever. He suggests that the Department of Defense must be willing and able to tap into commercial research, recognize its military potential and leverage it to develop new capabilities, while also accounting for the operational and organizational constructs to employ them faster than adversaries can.

Cleveland, Charles et al. *Military Strategy in the 21st Century: People, Connectivity and Competition*. Amherst, NY: Cambria Press, 2018.

This book discusses the changing character of warfare and strategic competition, arguing that if 20th century conflict and competition was characterized by military force backed by information operations, then in the 21st century, they are marked by information operations backed by military force. Accordingly, the authors call upon the U.S. to adopt an approach to conflict and competition that incorporates the *human domain* by leveraging global interconnectivity and the networks therein which help define and influence power.

Freier, Nathan P. et al. *At Our Own Peril: DoD Risk Assessment in a Post-Primacy World*. Strategic Studies Institute, U.S. Army War College, June 2017. <https://ssi.armywarcollege.edu/pdffiles/PUB1358.pdf>.

The authors of this study argue that the Department of Defense and the interagency as a whole have not adapted their risk identification, assessment, and communication processes to the characteristics and challenges of an era marked by the erosion of U.S. military superiority and the restructuring of the international security order, i.e., the post-U.S. primacy period. To address these challenges, the authors present a series of recommendations, including the adoption of “an objectives-based vice threat-based approach to enterprise-level risk assessment.”

Bernstein, Paul I. “Deterrence and Professional Military Education.” *Air and Space Power Journal* 29, no. 4 (July-August 2015): 84-88. https://www.airuniversity.af.mil/Portals/10/ASPJ/journals/Volume-29_Issue-4/ASPJ-Jul-Aug-2015.pdf.

Bernstein notes that while progress has been made in developing deterrence concepts that can guide operational planning, significant deficits remain. He suggests that professional military education (PME) lags behind in the attention it devotes to nuanced contemporary deterrence problems. He outlines a comprehensive approach for ensuring PME engages deterrence issues in a serious and systematic way, including increasing and updating its role in standard curricula.

Gerstein, Daniel M. "The Military's Search for Innovation." *The Rand Blog* (blog), August 13, 2018. <https://www.rand.org/blog/2018/08/the-militarys-search-for-innovation.html>.

Gerstein considers a brief history of the military's search for innovation and draws five key lessons that might be applied to the military's present innovative efforts. These include the insight that the establishment of formal centers for innovative thought do not guarantee innovation and that the role of culture in the success of innovation should not be underestimated.

Woods, Kevin M., and Thomas C. Greenwood. "Multidomain Battle. Time for a Campaign of Joint Experimentation." *JFQ* 88 (1st Quarter 2018).

http://ndupress.ndu.edu/Portals/68/Documents/jfq/jfq-88/jfq-88_14-21_Woods-Greenwood.pdf?ver=2018-01-09-102341-740.

Woods and Greenwood note that while the concept of operating across warfighting domains is far from new, the rapid growth of novel capabilities is forcing re-examination of military concepts and doctrine. They consider two approaches for exploring multidomain battle (MDB): the first by assessing MDB through the lens of existing evidence and the second by generating new evidence through experimentation.

Mattis, Peter. "From Engagement to Rivalry: Tools to Compete with China." *Texas National Security Review* 1, no. 4 (August 2018). <https://tnsr.org/2018/08/from-engagement-to-rivalry-tools-to-compete-with-china/>.

Mattis argues that the long-standing strategy of engagement vis-à-vis China, predicated on the assumptions that engaging China would lead to its embrace of the liberal order and that shared long-term interests would lead to cooperation, has failed. He points out that the new National Security Strategy marks a break from the old, standard position. He outlines a new approach for seeking opportunities to apply effective leverage on Chinese Communist Party officials and suggests how to rethink the connections between how China is analyzed and how policy is made.

Kramer, Franklin and James Wrightson, Jr. "Innovation, Leadership and National Security." Washington DC: Atlantic Council, April 2016.

www.atlanticcouncil.org/images/publications/Innovation_Leadership_and_National_Security_web_0411.pdf.

Kramer and Wrightson contend that innovation will be a crucial requirement for United States leadership and national security in the 21st century. They propose that both the United States government and private sector take significant steps to encourage innovation above and beyond what has already led to much successful innovative progress. They offer ten specific recommendations which emphasize enhancing deployment of the cluster model, increasing government focus on innovation, increasing corporate support of innovation, encouraging entrepreneurial development and expanding synergy between national security agencies and the private sector.

Summaries of Previous CGSR Symposia on Related Topics:

- Wilton Park. *Adapting Deterrence Strategies to a Changing Security Environment*. Workshop Summary. Wilton Park, 20-23 June 2018.
<https://cgsr.llnl.gov/content/assets/docs/IM-944328-1.pdf>.
- Center for Global Security Research, Lawrence Livermore National Laboratory. *Space in 21st Century Conflict: Calibrating Risks, Tailoring Strategies*. Workshop Summary. Livermore: CGSR, March 2018.
https://cgsr.llnl.gov/content/assets/docs/Space_Report_Final_03-012-18.pdf.
- Center for Global Security Research, Lawrence Livermore National Laboratory. *Strengthening Deterrence for 21st Century Strategic Conflicts and Competition: Accelerating Adaptation and Integration*. Workshop Summary. Livermore: CGSR, 14- 15 November 2017.
https://cgsr.llnl.gov/content/assets/docs/CDD_4_BHR_final_formatted.pdf.
- Center for Global Security Research, Lawrence Livermore National Laboratory. *U.S. Extended Deterrence in Europe and in the Asia-Pacific: Similarities, Difference, and Interdependencies*. Workshop Summary. Livermore: CGSR, 13 November 2017.
https://cgsr.llnl.gov/content/assets/docs/Summary_Report_ED_JAN2018final.pdf.
- Center for Global Security Research, Lawrence Livermore National Laboratory. *3rd Annual Cross-Domain Deterrence Seminar: Towards Integrated Strategic Deterrence*. Workshop Summary. Livermore: CGSR, 15-17 November 2016.
https://cgsr.llnl.gov/content/assets/docs/CDD_Report_Nov_2016_FINAL.pdf.
- Center for Global Security Research, Lawrence Livermore National Laboratory. *Space and the Third Offset*. Workshop Summary. Livermore: CGSR, 15-16 August 2016.
https://cgsr.llnl.gov/content/assets/docs/CGSR_3OS_Summary_Report_FINAL.pdf.
- Center for Global Security Research, Lawrence Livermore National Laboratory. *2nd Annual Cross-Domain Deterrence Seminar Report*. Workshop Summary. Livermore: CGSR, 17 November 2015.
https://cgsr.llnl.gov/content/assets/docs/CDD_Seminar_2015_Report.pdf.
- Center for Global Security Research, Lawrence Livermore National Laboratory. *Cross-Domain Deterrence Seminar Report*. Workshop Summary. Livermore: CGSR, 1 May 2015.
<https://cgsr.llnl.gov/content/assets/docs/SummaryNotes.pdf>.

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